WATER-YIELD AND WATER-QUALITY STUDY OF OTHER SOURCES TRIBUTARY TO STANDLEY LAKE AND GREAT WESTERN RESERVOIR ROCKY FLATS PLANT

Task 16
of the
Zero-Offsite Water-Discharge Study

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Rocky Flats Plant

EXECUTIVE SUMMARY

This report has been prepared for one of several studies being conducted for, and in conjunction with, the Zero-Offsite Water-Discharge Study, prepared in response to Item C.7 of the Agreement in Principle between the Colorado Department of Health (CDH) and the U.S. Department of Energy (DOE) (ASI, 1990a). The CDH/DOE Agreement Item C. 7 states "Source Reduction and Zero Discharges Study: Conduct a study of all available methods to eliminate Rocky Flats discharges to the environment including surface waters and ground water. This review should include a source reduction review."

Specifically, this study was conducted to assess the relative importance of water yields from the Rocky Flats Plant (RFP), compared to other water sources flowing into both Standley Lake and Great Western Reservoir (ASI, 1990b). An important issue related to impacts of zero discharge of surface waters from the RFP is the loading of selected water-quality constituents to Standley Lake and Great Western Reservoir from ditches diverting water from Clear Creek and Coal Creek. The relative quantities of water imported to the municipal reservoirs from the ditches has been assessed relative to the runoff from the Walnut Creek and Woman Creek watersheds as reported by ASI (1990c). In addition, this study has identified and quantified the water-quality loads from imported water flowing into the two storage reservoirs.

Standley Lake serves as a source of municipal water supply for the Cities of Westminster, Northglenn and Thornton. In addition to receiving runoff from the Woman Creek watershed, Standley Lake is augmented with water diverted from Coal Creek through Kinnear Ditch and Last

Chance Ditch, and with water diverted from Clear Creek through Croke Canal, Church Ditch and Farmer's Highline Ditch. Great Western Reservoir serves as a source of water supply for the City of Broomfield. In addition to runoff from the Walnut Creek watershed, Great Western Reservoir receives water diverted from Coal Creek through McKay (also known as Zang) Ditch, and it receives water diverted from Clear Creek through Church Ditch.

Water Yield Great Western Reservoir

According to inflow records kept by the City of Broomfield, an annual average of approximately 65 percent (2,020 ac-ft) of flow into Great Western Reservoir has been supplied by Clear Creek through Church Ditch since 1982. In that same time period, approximately 10 percent (310 ac-ft) of Great Western Reservoir's annual inflow came from Coal Creek through McKay Ditch. Therefore, about 25 percent (780 ac-ft) of the storage reservoir's inflow came from the Walnut Creek watershed, which is in part located within the RFP area.

Water Yield Standley Lake

Standley Lake receives, on an annual basis, an average of approximately 17,200 ac-ft of Clear Creek water through Croke Canal (12,000 ac-ft) and Farmer's Highline Ditch (5,200 ac-ft), according to the Colorado State Engineer's (State Engineer) records. The municipal reservoir also receives an annual average of approximately 400 ac-ft diverted from Coal Creek through Kinnear Ditch, which flows through the RFP, according to the State Engineer's records.

Some of the values obtained from the State Engineer's office are incomplete or unclear regarding the amount of water diverted from the canals to storage, versus the amount applied as irrigation. Consequently, data reported in a technical memorandum to the Cities of Thornton and Westminster for the years 1981 through 1983 (Arber Associates, 1984) were used for the purpose of comparison. According to the Arber Associates report for those three years, an average of approximately 28,000 ac-ft per year (84 percent of the total amount of water received) were

diverted to Standley Lake through Croke Canal and Farmer's Highline Ditch and approximately 5,200 ac-ft per year (16 percent of the total amount of water received) were received by Standley Lake through Kinnear and Last Chance Ditches during that period. The figure of 5,200 ac-ft per year includes the amount diverted from Coal Creek through Kinnear Ditch and Last Chance Ditch as well as runoff from the Woman Creek watershed, which is in part, located within the RFP area. For purposes of computing loading of chemical and radiochemical constituents to Standley Lake, the annual average reported to the Cities of Westminster and Thornton by Arber Associates was used.

Water Quality

The U.S. Geological Survey (USGS) and the CDH have collected water-quality data for Clear Creek in the Golden area. Their values are judged to be representative of water diverted to Great Western Reservoir and Standley Lake through Church Ditch, Croke Canal and Farmer's Highline Ditch. The USGS also collected water-quality information from Coal Creek at their discontinued gaging station west of the RFP near Plainview. These data are considered to be representative of the water diverted through McKay Ditch, Last Chance Ditch, and Kinnear Ditch. A summary of averages for selected water-quality constituents from the CDH and USGS data follows on Table ES*-1 (*Executive Summary). Great Western Reservoir average water-quality constituent values, furnished by the City of Broomfield, are also included.

Table ES-1

Average Water-Quality Values for Clear Creek, Coal Creek and Great Western Reservoir.

SITE	TDS (mg/l)	Copper (mg/l)	Lead (mg/l)	Gross Alpha (pCi/l)	Beta (pCi/l)
Clear Cr. at Golden (USGS)	130	0.048	0.010	--	--
Clear Cr. above Golden (CDH)	150	0.060	0.018	11	
Coal Cr. near Plainview (USGS)	130	--	--	--	--
Great Western Res. (Broomfield)	180	0.008	<0.02	3	6

Estimates of chemical- and radiochemical-constituent loading to Standley Lake and Great Western Reservoir from imported sources are summarized on Table ES-2.

Table ES-2

Estimated Chemical and Radiochemical Loading to Standley Lake and Great Western Reservoir from Imported Water Sources.

WATER SOURCE	TDS (tons/yr)	Cadmium (lb/yr)	Copper (lb/yr)	Gross Lead (lb/yr)	Alpha (Pci/yr)	Beta (Pci/yr)	Uranium (lb/yr)
STANDLEY LAKE							
Clear Creek							
Croke Canal	2,500	71	1,800	650	1.8×10^{11}	1.8×10^{11}	1,800
Farmer's Highline	2,800	79	2,000	570	2.0×10^{12}	2.0×10^{12}	2,000
Coal Creek							
Kinnear Ditch	600						
Last Chance Ditch	29						
GREAT WESTERN RESERVOIR							
Clear Creek							
Church Ditch	400	11	270	77	2.7×10^{11}	2.7×10^{11}	270
Coal Creek							
McKay Ditch	53						

WATER-YIELD AND WATER-QUALITY STUDY OF OTHER SOURCES TRIBUTARY TO STANDLEY LAKE AND GREAT WESTERN RESERVOIR

Rocky Flats Plant

1.0 INTRODUCTION

This report has been prepared for one of several studies being conducted for, and in conjunction with, the Zero-Offsite Water-Discharge Study, in response to Item C.7 of the Agreement in Principle between the Colorado Department of Health (CDH) and the U.S. Department of Energy (DOE) (ASI, 1990a). The CDH/DOE Agreement Item C. 7 states "Source Reduction and Zero Discharges Study: Conduct a study of all available methods to eliminate Rocky Flats discharges to the environment including surface waters and ground water. This review should include a source reduction review."

Specifically, this study was conducted to assess the relative importance of water yields from the Rocky Flats Plant (RFP), compared to other water sources flowing into both Standley Lake and Great Western Reservoir (ASI, 1990b). An important issue related to impacts of zero discharge of surface waters from the RFP is the loading of selected water-quality constituents to Standley Lake and Great Western Reservoir from ditches diverting water from Clear Creek and Coal Creek. The relative quantities of water imported to the municipal reservoirs from the ditches has been assessed relative to the runoff from the Walnut Creek and Woman Creek watersheds as reported by ASI (1990c). In addition, this study has described the quality of imported water and quantified the water-quality loads from imported water flowing into the two storage reservoirs.

2.0 SOURCES AND AMOUNTS OF WATER YIELD TO STANDLEY LAKE AND GREAT WESTERN RESERVOIR

2.1 STANDLEY LAKE

Water is diverted from Clear Creek and transported to Standley Lake through Croke Canal, Church Ditch, and Farmer's Highline Ditch (Figure 1). According to the Colorado State Engineer's (State Engineer) records, since 1970, an average of approximately 12,000 acre-feet (ac-ft) per year have been diverted to Standley Lake through Croke Canal, and an annual average of approximately 5,200 ac-ft have been diverted to that reservoir through Farmer's Highline Ditch (Table 1 and Appendix B/Table B-1). Therefore, on an annual basis, an average of approximately 17,200 ac-ft of Clear Creek water has been diverted to Standley Lake, based on interpretations of State Engineer records.

Coal Creek water is diverted through Kinnear Ditch and Last Chance Ditch to Standley Lake (Figure 1). Kinnear Ditch water flows into Woman Creek, which flows through the southern part of the RFP. The annual average amount of Coal Creek water diverted to Standley Lake through Kinnear Ditch, based on State Engineer records available since 1970, is 400 ac-ft, and 310 ac-ft of Coal Creek water has been diverted through Last Chance Ditch (Table 1 and Appendix A/Table A-1).

For some years, State Engineer records are unclear as to the amount of water stored in Standley Lake and the amount applied to land as irrigation or used for other purposes. In other years no information is available. Some records indicate that water was diverted into one or another ditch, but no quantity is specified. Therefore, the aforementioned annual input quantities from Croke Canal, Farmer's Highline Ditch, Church Ditch, Last Chance Ditch, and Kinnear Ditch were considered incomplete and an additional source of data was sought.

Table 1

Imported Water Yield to Standley Lake

AVERAGE ANNUAL WATER YIELD, ac-ft

STANDLEY LAKE

	State Engineer	Arber Associates
Clear Creek		
Croke Canal	12,000	13,127
Farmer's Highline Ditch	5,200	14,761
Coal Creek		
Kinnear Ditch	400	3,413*
Last Chance Ditch	310	1,779

* includes runoff from Woman Creek watershed

In a technical memorandum to the Cities of Thornton and Westminster prepared by Arber Associates, 1984, Standley Lake inflow from Coal Creek and Clear Creek through the ditches is reported for the years 1981 through 1983. Table 1 presents values of water-inflow to Standley Lake for the years 1981 through 1983 as reported by both the State Engineer and Arber Associates. Because of uncertainties in interpreting State Engineer records, the values reported by Arber Associates were judged to be more reliable, and were used in subsequent chemical- and radiochemical loading analyses.

2.2 GREAT WESTERN RESERVOIR

Sources of water imported to Great Western Reservoir include Clear Creek water which is diverted through Church Ditch, and Coal Creek water which is diverted through McKay (also referred to as Zang) Ditch. McKay Ditch flows onto RFP property, into McKay Bypass Ditch, and into Walnut Creek, which is tributary to Great Western Reservoir.

Since 1970, State Engineer records indicate that an annual average of approximately 3,000 ac-ft were diverted to the municipal reservoir through Church Ditch. From 1982 through 1989, according to City of Broomfield records, an annual average of approximately 2,000 ac-ft were diverted to Great Western Reservoir through Church Ditch. For the period between 1982 and 1989, State Engineer and City of Broomfield records for Church Ditch input to Great Western Reservoir differ considerably (Appendix A/Table A-2). For example, in 1984, State Engineer records state that 8,486 ac-ft were diverted to storage, whereas City of Broomfield records state that 1,490 ac-ft were received from Church Ditch. In 1986, 7,065 and 2,632 ac-ft of Clear Creek water were diverted to Great Western Reservoir through Church Ditch, according to State Engineer and City of Broomfield records, respectively. Because State Engineer records were sometimes unclear regarding the amount of water diverted, where it was transported, and how it was used, City of Broomfield records are judged to be more accurate. For subsequent water-quality loading analyses, City of Broomfield amounts were used.

For most years since 1970, State Engineer records of McKay Ditch input to Great Western Reservoir are missing or incomplete. City of Broomfield records from 1982 through 1989 indicate that an annual average of 300 ac-ft of water were imported to Great Western Reservoir through McKay Ditch (Table 2 and Appendix A/Table A-2).

According to City of Broomfield records, approximately 770 ac-ft per year were input to Great Western Reservoir from Walnut Creek (Appendix A/Table A-2). Table 2 summarizes annual averages of water imported to Great Western Reservoir.

Table 2

Imported Water Yield to Great Western Reservoir

GREAT WESTERN RESERVOIR

	State Engineer	City of Broomfield
Clear Creek		
Church Ditch	3,000	2,000
Coal Creek		
McKay Ditch	--*	300

* State Engineer's records insufficient to estimate average annual yield to Great Western Reservoir from Coal Creek via McKay Ditch (see Appendix A/Table A-2).

3.0 QUALITY OF WATER IMPORTED TO STANDLEY LAKE AND GREAT WESTERN RESERVOIR

Samples for water-quality analysis have been collected by the USGS from Clear Creek at Golden, and from Coal Creek west of the RFP near Plainview (USGS, 1977 through 1984). Additionally, the CDH collects water-quality data from their sampling site referred to as Clear Creek above Golden. These three sites are relatively near the head gates of Croke Canal, Farmer's Highline Ditch, Church Ditch, Kinnear Ditch and McKay Ditch. The quality of water at the Clear Creek and Coal Creek locations, as defined by their records, is considered representative of the quality of water imported to Standley Lake and Great Western Reservoir through their respective ditches. Appendix B presents tables of water-quality data for the Clear Creek and Coal Creek sampling sites. Also, in Appendix B, for informational purposes, are tables of water-quality data for a USGS sampling site on Ralston Creek, and data supplied by the City of Broomfield for Great Western Reservoir.

Chemical and radiochemical constituents selected for loading analysis include total dissolved solids (TDS), cadmium, copper, lead, beryllium, gross alpha, gross beta, and uranium. Other radionuclides, including americium-241, plutonium-239, and tritium, were selected for loading analysis, but concentration data for these constituents from imported-water sources are not available. Analyses for all of the selected chemical and radiochemical constituents are not available for all the Clear Creek and Coal Creek sampling sites. Table 3 summarizes average values of chemical- and radiochemical-constituent concentrations for the selected water-quality constituents. It should be noted that the values on Table 3 are simple averages and are not discharge weighted.

Table 3

Average Water-Quality Values for Clear Creek, Coal Creek and Great Western Reservoir.

SITE	TDS (mg/l)	Copper (mg/l)	Lead (mg/l)	Gross Alpha (pCi/l)	Beta (pCi/l)
Clear Cr. at Golden (USGS)	130	0.048	0.010	--	--
Clear Cr. above Golden (CDH)	150	0.060	0.018	11	
Coal Cr. near Plainview (USGS)	130	--	--	--	--
Great Western Res. (Broomfield)	180	0.008	<0.02	3	6

4.0 WATER-QUALITY LOADING

Loading of water-quality constituents is estimated by multiplying the chemical- or radiochemical-constituent concentration by the water discharge and applying appropriate units-conversion factors. If average chemical-constituent concentrations are used, then it is appropriate to use discharge-weighted averages. As discussed previously, the average chemical-constituent concentrations used for this report are simple averages and were not discharge weighted. However, the simple averages represent the best data available and allow for reasonable estimates of chemical and radiochemical loading. Table 4 summarizes estimates of chemical and radiochemical loading of selected constituents to Standley Lake and Great Western Reservoir from water imported from Clear Creek and Coal Creek.

Table 4

Estimated Chemical and Radiochemical Loading to Standley Lake and Great Western Reservoir from Imported Water Sources.

WATER SOURCE	TDS (tons/yr)	Cadmium (lb/yr)	Copper (lb/yr)	Gross Lead (lb/yr)	Alpha (Pci/yr)	Beta (Pci/yr)	Uranium (lb/yr)
			STANDLEY LAKE				
Clear Creek							
Croke Canal	2,500	71	1,800	650	$1.8x10^{11}$	$1.8x10^{11}$	1,800
Farmer's Highline	2,800	79	2,000	570	$2.0x10^{12}$	$2.0x10^{12}$	2,000
Coal Creek							
Kinnear Ditch	600						
Last Chance Ditch	29						
			GREAT WESTERN RESERVOIR				
Clear Creek							
Church Ditch	400	11	270	77	$2.7x10^{11}$	$2.7x10^{11}$	270
Coal Creek							
McKay Ditch	53						

5.0 ACKNOWLEDGEMENTS

This study was conducted under the general supervision of Michael G. Waltermire, P.E., Project Manager, Advanced Sciences, Inc. (ASI). Mr. Stephen J. Playton, P.H., a subconsultant to ASI, prepared this report. The report was reviewed by Dr. James R. Kunkel, P.E., P.H., Senior Hydrologist, ASI and by Dr. Timothy D. Steele, P.H., Manager, Physical Sciences Group, ASI.

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This report is submitted in partial fulfillment of the Zero-Offsite Water-Discharge study being conducted by ASI on behalf of EG&G, Rocky Flats, Inc. EG&G's Project Engineer was R. A. Applehans of EG&G, Facilities Engineering, Plant Civil/Structural Engineering (FE/PCSE).

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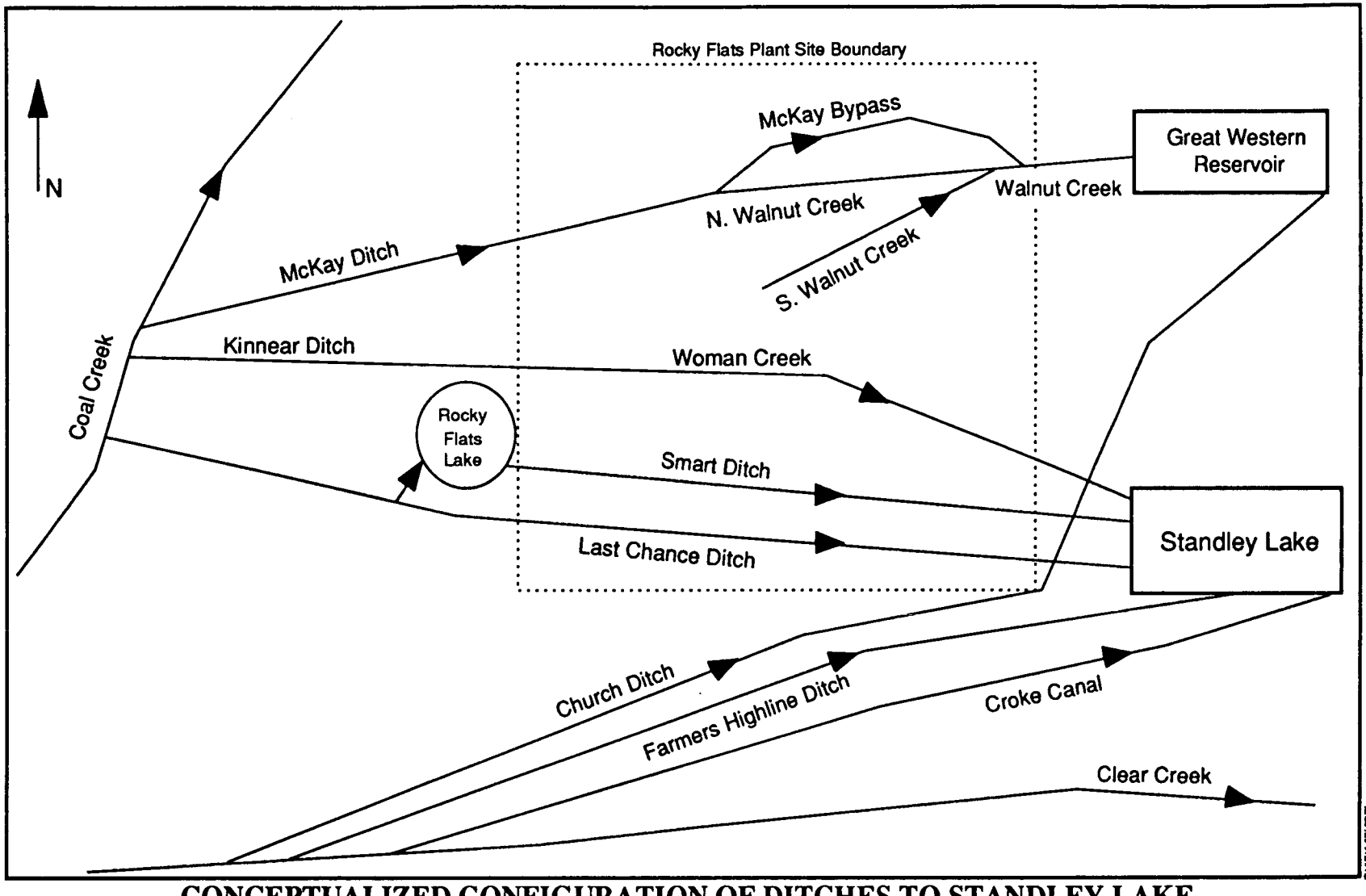

CONCEPTUALIZED CONFIGURATION OF DITCHES TO STANDLEY LAKE AND GREAT WESTERN RESERVOIR

Water-Yield and Water-Quality Study of Other Sources
Tributary to Standley Lake and Great Western Reservoir
Zero-Offsite Water Discharge

PROJECT No. 208.0116

FIGURE No. 1

A

APPENDIX A

WATER YIELD TO STANDLEY LAKE AND GREAT WESTERN RESERVOIR

Table A-1

Imported Water Yield to Standley Lake

	IMPORTED WATER, (ac-ft)									
YEAR	LAST CHANCE DITCH[1]	LAST CHANCE & CHURCH DITCH[2]	CROKE CANAL[1]	CROKE CANAL[2]	FARMER'S HIGHLINE DITCH[1]	FARMER'S HIGHLINE DITCH[2]	KINNEAR DITCH[1]	KINNEAR DITCH[2]	TOTAL[1]	TOTAL[2]
1970	0		23,334		5,480		0		28,814	
1971	0		5,451		4,715		0		10,166	
1972	78		18,078		1,994		0		20,150	
1973	0		25,157		6,536		0		31,693	
1974	*		16,049		2,714		*		--	
1975	370		8,596		600		*		--	
1976	109		14,735		0		469		15,313	
1977	203		11,276		0		214		11,693	
1978	284		18,875		123		271		19,553	
1979	609		17,367		595		1,327		19,898	
1980	214		8,690		1,006		1,190		11,000	
1981	342	875	14,611	13,193	841	9,342	*	1,378	--	24,788
1982	0	2,113	15,880	15,263	13,966	23,832	0	2,674	29,846	43,882
1983	961	2,349	8,843	10,926	4,787	11,108	*	6,186	--	30,579
1984	445		2,657		6,411		@		--	
1985	720		6,521		11,283		125		18,649	
1986	660		6,329		20,891		994		28,874	
1987	187		1,684		16,042		145		18,058	
1988	399		8,467		0		817		9,683	
AVERAGE[3]	310	1,779	12,000	13,127	5,200	14,760	400	3,412	20,000	33,083

NOTES:

[1] - Values obtained from Colorado State Engineer files.

[2] - Values from Arber Associates (1984).

[3] - Averages calculated for the years data were available, and rounded to two significant digits.

* - no information available.

@ - records state water used or diverted to storage, but quantity unspecified.

-- - insufficient data available to make calculation.

Source of Water in Croke Canal, and Church and Farmer's Highline Ditches is Clear Creek.

Source of Water in Last Chance and Kinnear Ditches is Coal Creek.

Table A-2

Water Yield to Great Western Reservoir

	WATER YIELD, ac-ft						
YEAR	CHURCH DITCH[1]	CHURCH DITCH[2]	MCKAY DITCH[1]	MCKAY DITCH[2]	WALNUT CREEK[2]	TOTAL[1]	TOTAL[2]
1970	1,148	*	0	*	*	1,148	*
1971	1,292	*	0	*	*	1,292	*
1972	1,372	*	0	*	*	1,372	*
1973	521	*	0	*	*	521	*
1974	1,870	*	*	*	*	--	*
1975	1,364	*	@	*	*	--	*
1976	0	*	0	*	*	0	*
1977	0	*	0	*	*	0	*
1978	0	*	0	*	*	0	*
1979	0	*	*	*	*	--	*
1980	0	*	*	*	*	--	*
1981	397	*	*	*	*	--	*
1982	5,584	2,959	*	156	379	--	3,494
1983	1,110	843	*	413	2,023	--	3,279
1984	8,486	1,490	*	115	830	--	2,435
1985	7,439	1,584	*	170	385	--	2,139
1986	7,065	2,632	*	159	663	--	3,454
1987	3,859	1,183	*	718	1,009	--	2,910
1988	56	2,070	276	641	766	332	3,477
1989	*	3,577	*	0	129	*	3,706
AVERAGE[3]	3,000	2,000	--	300	770	--	3,100

NOTES:

[1] - Values obtained from Colorado State Engineer records.

[2] - Values obtained from City of Broomfield records.

[3] - Averages calculated for the years data were available, and rounded to two significant digits.

* - no information available.

@ - records state water used or diverted to storage, but quantity unspecified.

-- - insufficient data available to make calculation.

B

APPENDIX B

WATER-QUALITY DATA

Table B-1

Water-Quality Data for USGS Site - 06719505 - Clear Creek at Golden.

Date	TDS, Sum of Constituents (mg/l)	Total Cadmium (ug/l)	Total Copper (ug/l)	Total Lead (ug/l)
1981 Apr	193	0	41	4
Jul	88	1	23	6
1982 Mar	197	2	41	4
Jul	60	2	13	1
Sep	87	--	--	--
Nov	140	2	34	2
1983 Mar	200	4	85	8
Jun	66	3	87	52
Sep	110	--	--	--
Dec	150	--	--	--
1984 Feb	190	3	68	14
Jun	69	1	36	2
Sep	94	--	--	--
AVERAGE	126	2	48	10

Table B-2

Summary of Average Water-Quality Values for CDH Site Clear Creek above Golden.

Total Dissolved Solids (mg/l)	Copper (ug/l)	Lead (ug/l)	Gross Alpha (pCi/l)	Gross Beta (pCi/l)	Uranium (ug/l)	Beryllium (ug/l)
150	60	18	11	11	5	50

Table B-3

Water-Quality Data for USGS Site - 06719740 - Ralston Creek above Ralston Reservoir near Golden.

Date	TDS, Residue @105 de (mg/l)	Total Cadmium (ug/l)	Total Copper (ug/l)	Total Lead (ug/l)	Gross Alpha (pCi/l)	Gross Beta (pCi/l)	Total Uranium (pCi/l)
1983 May	101	<1	13	14	--	--	21
	110	1	17	20	--	--	30
	101	1	21	22	--	--	38
	153	1	8	7	--	--	21
	104	<1	7	22	--	--	17
	107	<1	6	2	--	--	17
	113	<1	8	5	--	--	21
	100	<1	28	28	--	--	30
	144	<1	36	70	--	--	89
Jun	123	<1	2	2	--	--	11
	118	<1	4	2	--	--	10
	142	<1	8	<1	1.7	1.8	12
	160	<1	6	2	--	--	10
	145	<1	4	2	--	--	10
	130	<1	4	2	--	--	81
	114	<1	9	3	--	--	20
	136	<1	3	<1	3.1	2.7	15
	137	<1	5	3	3.3	2.2	14
Sep	490	<1	5	1	0.6	12	110
	153	1	9	4	5.3	22	100
	490	<1	3	1	1	12	100
	545	1	4	<1	1.3	7	110
	124	<1	4	1	0.8	13	120
	486	<1	4	1	0.9	8	120
	512	<1	3	2	2.2	12	84
	526	<1	4	1	2.5	14	94
	452	<1	3	1	0.8	9.4	92
Dec	418	--	9	1	1.6	5.3	77
	412	--	4	1	0.9	4.1	80
	389	--	4	1	--	--	84
	455	--	8	5	--	--	84
	443	--	5	3	1.9	4.1	80
	479	--	25	6	--	--	71
	439	--	4	3	--	--	78
	444	--	18	9	16	16	99
	431	--	6	3	8.7	9	89

Table B-3 (Con't.)

Water-Quality Data for USGS Site - 06719740 - Ralston Creek above Ralston Reservoir near Golden (continued)

Date	TDS, Residue @105 °C (mg/l)	Total Cadmium (ug/l)	Total Copper (ug/l)	Total Lead (ug/l)	Gross Alpha (pCi/l)	Gross Beta (pCi/l)	Total Uranium (pCi/l)
1984 May	94	--	13	9	--	--	12
	123	--	11	8	--	--	9.7
	85	--	10	3	--	--	7.8
1984 May	94	--	10	3	--	--	8.8
	90	--	6	5	--	--	7.3
	94	--	8	17	--	--	6.9
	95	--	7	5	--	--	7.1
	95	--	8	2	--	--	6.5
	98	--	8	13	--	--	5.7
Aug	337	--	3	6	--	--	30
	293	--	5	5	--	--	30
	361	--	5	4	--	--	40
	344	--	15	13	--	--	32
	391	--	5	5	--	--	37
	406	--	3	<1	--	--	42
	390	--	6	3	--	--	37
	439	--	4	3	--	--	38
	455	--	7	3	--	--	38
AVERAGE[1]	263	<1	8	7	3.1	9.1	47

NOTE:

[1] - Averages calculated for number of values available.

Table B-4

Water-Quality Data for Discontinued USGS Site - 06730300 - Coal Creek Near Plainview

Total Dissolved Solids, Sum of Constituents, (mg/l)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
1977								78	111	112	132	135	114
1978	129	112	106	114	105	98	134	91	92	206	231	283	142
1979	257	122	121	140	124	118	80	69	62	94	141	132	122
1980	154	117	111	110	138	117	110	64	65	91	255	313	137
1981	341	130	110	159	102	151	100	72	89	110	135	165	139
1982	159	142	121	133	119	129	132	79	84	113	148	134	124
AVG	208	125	114	131	118	123	111	76	84	121	174	194	130

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Table B-5

Annual-Average Water-Quality Constituent Values for Great Western Reservoir (City of Broomfield)

YEAR	Total Dissolved Solids (mg/l)	Copper (mg/l)	Lead (mg/l)	Gross Alpha (pCi/l)	Gross Beta (pCi/l)	Tritium (pCi/l)	Plutonium (pCi/l)	Americium (pCi/l)	Uranium (pCi/l)
1983	253	<0.01	0.027	5.3	10.2	--	--	--	--
1984	--	<0.01	<0.005	3.2	7	<374	--	--	--
1985	195	0.006	<0.005	2.7	5.6	<389	--	--	--
1986	177	0.01	0.016	2.2	5.3	75	0.008	0.00	2.1
1987	167	0.009	<0.008	1.5	4.1	125	0.007	0.00	2.4
1988	174	0.009	<0.006	1.5	3.7	<350	0.004	0.00	1.9
1989	149	0.007	<0.003	1.9	2.8	<350	0.005	0.00	1.37

Table B-6

Colorado Stream Standards for Walnut Creek and Woman Creek Segments

CONSTITUENT	(units)	SEGMENTS 4 & 5 WOMAN CREEK AQUATIC LIFE	AGRI-CULTURE	DRINKING WATER	SEGMENTS 4 & 5 WALNUT CREEK AQUATIC LIFE	AGRI-CULTURE	DRINKING WATER
TDS*	(mg/l)			500			500
Beryllium*	(mg/l)	--	0.100	--	--	0.100	--
Copper	(mg/l)	@	0.200	1.000	@	0.200	1.000
Lead	(mg/l)	&	0.100	0.050	&	0.100	0.050
Plutonium-239	(pCi/l)	--	--	0.05+	--	--	0.05+
Americium-241	(pCi/l)	--	--	0.05+	--	--	0.05+
Uranium$	(pCi/l)	--	--	5+	--	--	10+
Gross Alpha	(pCi/l)	--	--	7+	--	--	11+
Gross Beta	(pCi/l)	--	--	5+	--	--	19+
Tritium	(pCi/l)	--	--	500+	--	--	500+

NOTES:
Segment 4 is defined as the mainstems and all tributaries to Woman and Walnut Creeks from sources to Standley Lake and Great Western Reservoir except for specific listings in Segment 5.

Segment 5 is defined as mainstems of North and South Walnut Creek, including all tributaries, lakes and reservoirs, from their sources to the outlet of ponds A-4, B-5 and C-2.

* -Standards not specifically given for Segments 4 & 5.

@ -acute concentration, limit = $1/2\ e^{(0.9422[\ln(\text{hardness})]-0.7703)}$
chronic concentration, limit = $e^{(0.8545[\ln(\text{hardness})]-1.465)}$

& -acute concentration, limit = $1/2\ e^{(1.6148[\ln(\text{hardness})]-2.1805}$
chronic concentration, limit = $e^{(1.417[\ln(\text{hardness})]-5.167}$

+ -Standards not set based on water use.

$ -Limits not given for specific uranium isotopes.